Controller Pilot Data Link Communications (CPDLC) over VHF Digital Link (VDL) Mode 2

ICNS Conference

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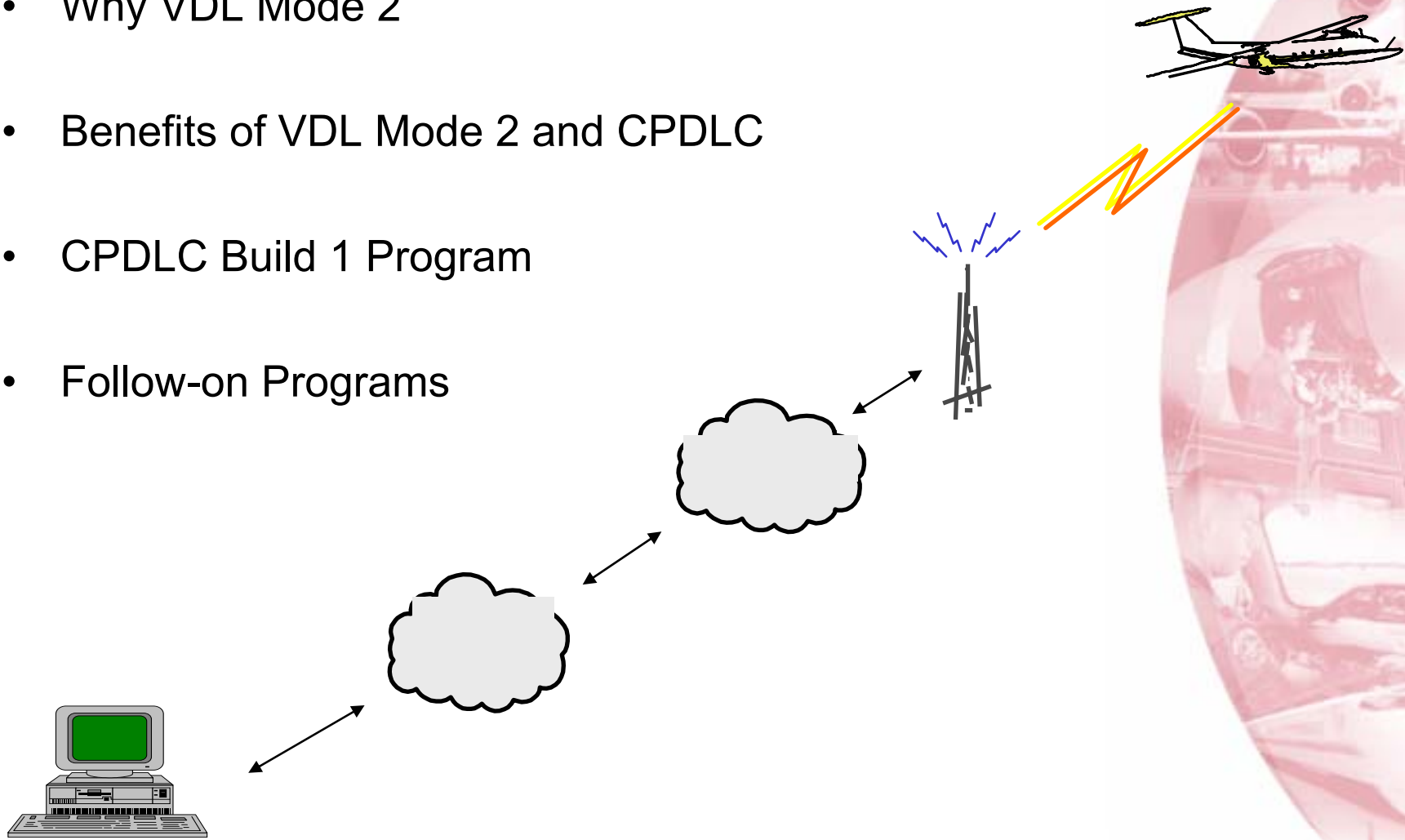
Outline

- Why VDL Mode 2
- Benefits of VDL Mode 2 and CPDLC
- CPDLC Build 1 Program
- Follow-on Programs



Airline VHF Data Link Communications is Transitioning to VDL Mode 2

- ACARS Enhancement
- U.S. CPDLC Program
- European LINK 2000+ Project Pioneer
- AVICOM (Japan)
- Major airlines

Aircraft Communications Addressing and Reporting System (ACARS)

- ARINC statistics – 2003

  - 8,000 aircraft with 100 airlines / customers
  - 800 ground stations
  - 630 locations in 20 countries
  - 23 million messages per month
  - 10 frequencies in North America

  - 80% Aeronautical Operational Communications (AOC)
  - 20% Air Traffic Services (ATS)
    (DATIS, PDC, TWIP)

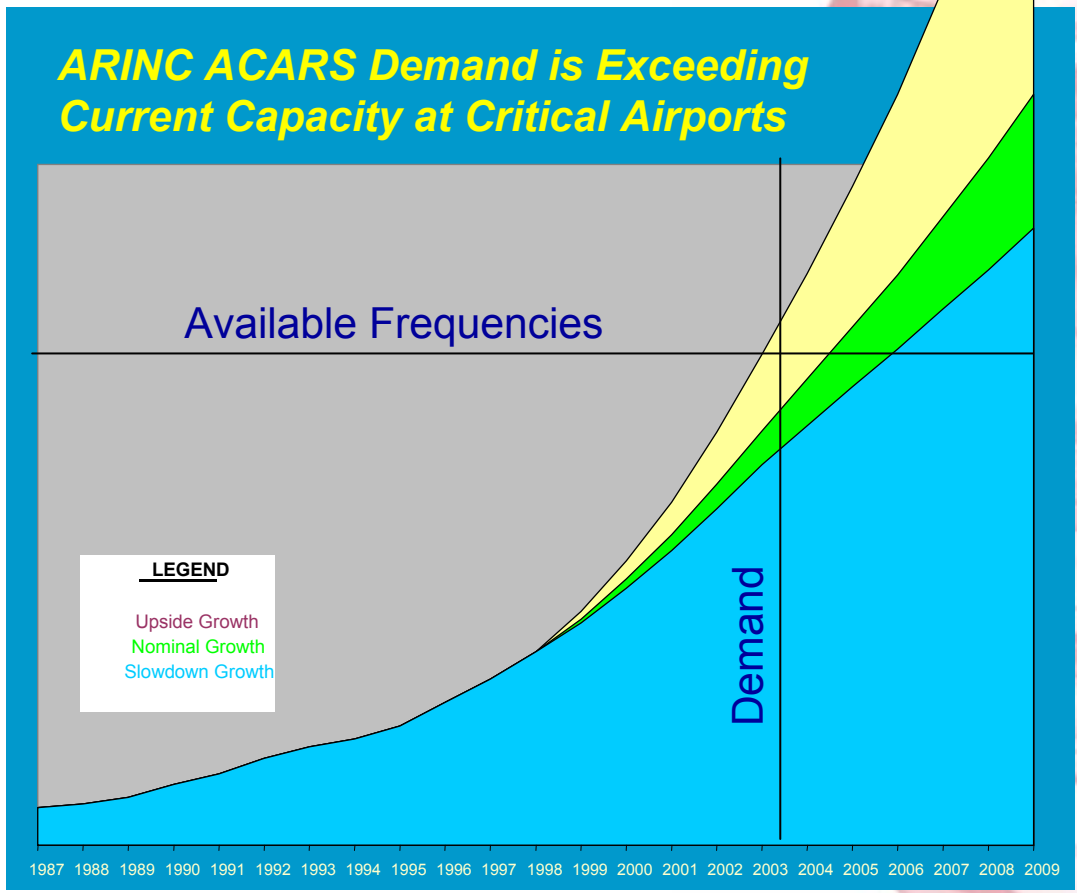
ACARS is essential to major airlines' operations

ACARS Technology Limitations

- ACARS has 2.4 KBPS air-to-ground data link
  - Current traffic reaching capacity of available frequencies at busiest airports
  - Limits data link speed and volume
- Data link growth continues regardless of economy
- Cannot continue to meet airlines demand
  - New applications are data intensive

VDL Mode 2 Relieves VHF ACARS Frequency Demands

- Allows continuing air traffic growth
- Enables new uses for data link communications
- Augments VHF ACARS worldwide

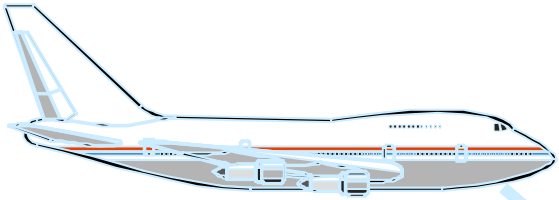


2003

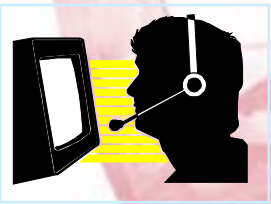
VHF Data Link Mode 2

- VDL Mode 2 has 31.5 KBPS air-to-ground data link
  - >10X the throughput and speed of ACARS
  - Enables data intensive applications
  - Complies with ICAO SARPS for worldwide harmonization
  - Eliminates radio frequency congestion
- Designed to meet demanding requirements of Air Traffic Services (ATS) communications
- Scalable system
  - Expandable with demand

CPDLC over VDL Mode 2



- VDL Mode 2 enables Controller Pilot Data Link Communications (CPDLC) in domestic airspace
- Uses ICAO standards for Aeronautical Communications Network (ATN)
- Adopted by FAA and CAAs
  - USA, Europe, Japan
- Available and Operational NOW



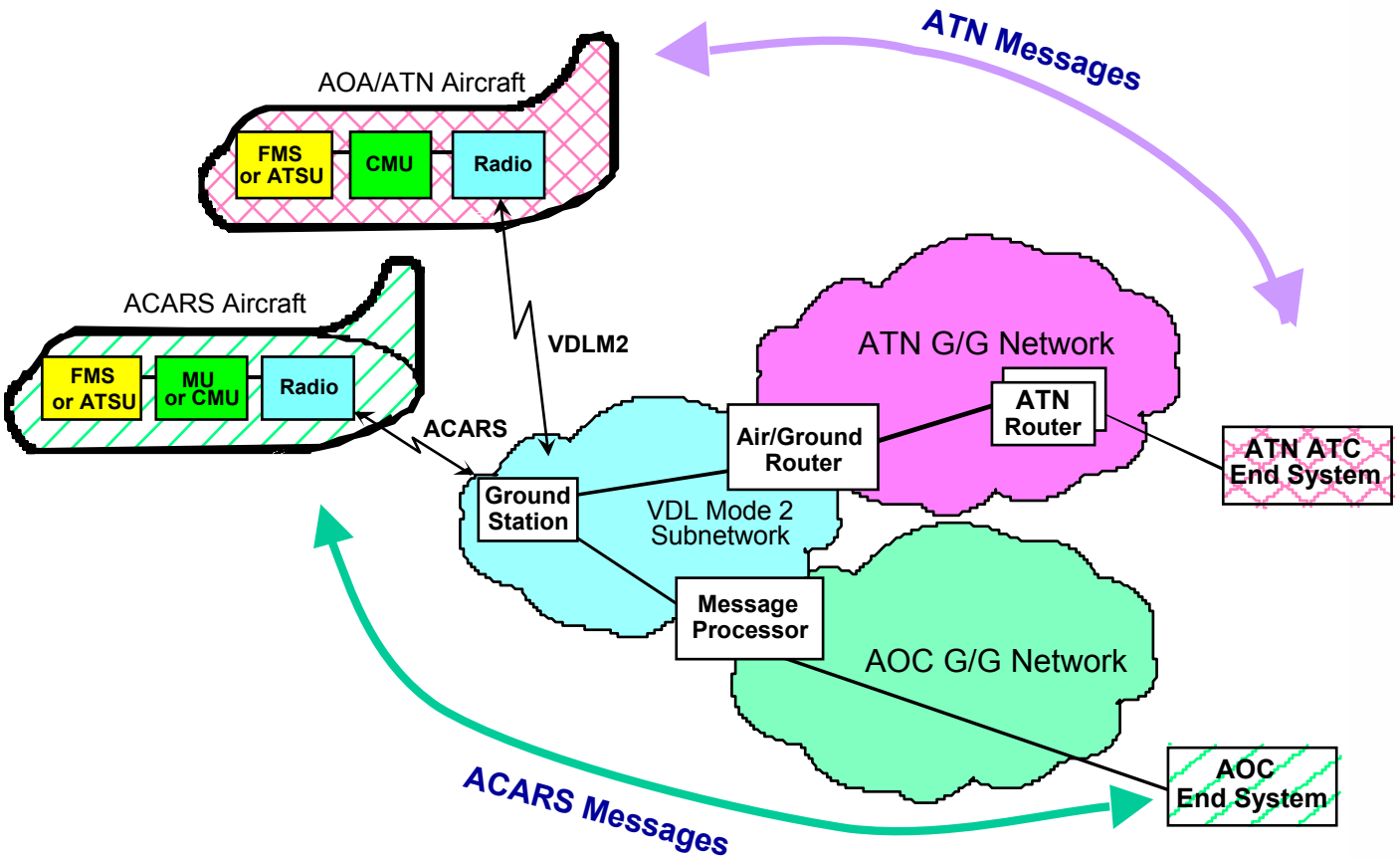
VDLM2 Vs. ACARS

	ACARS	VDLM2
Standards	ARINC standard	ICAO standard
Bit or character	Character	Bit
Raw channel data rate	2400 bps	31,500 bps
Channel throughput	300-600 bps	10,000-12,000 bps
Undetected error rate	10^{-6} 10^{-10} with ARINC 622	>10^{-10} with TP4
ARINC network message delivery (one-way)	> 5 seconds mean	<3.5 seconds 95%
Type of service	Connection-less	Connection-oriented broadcast capable

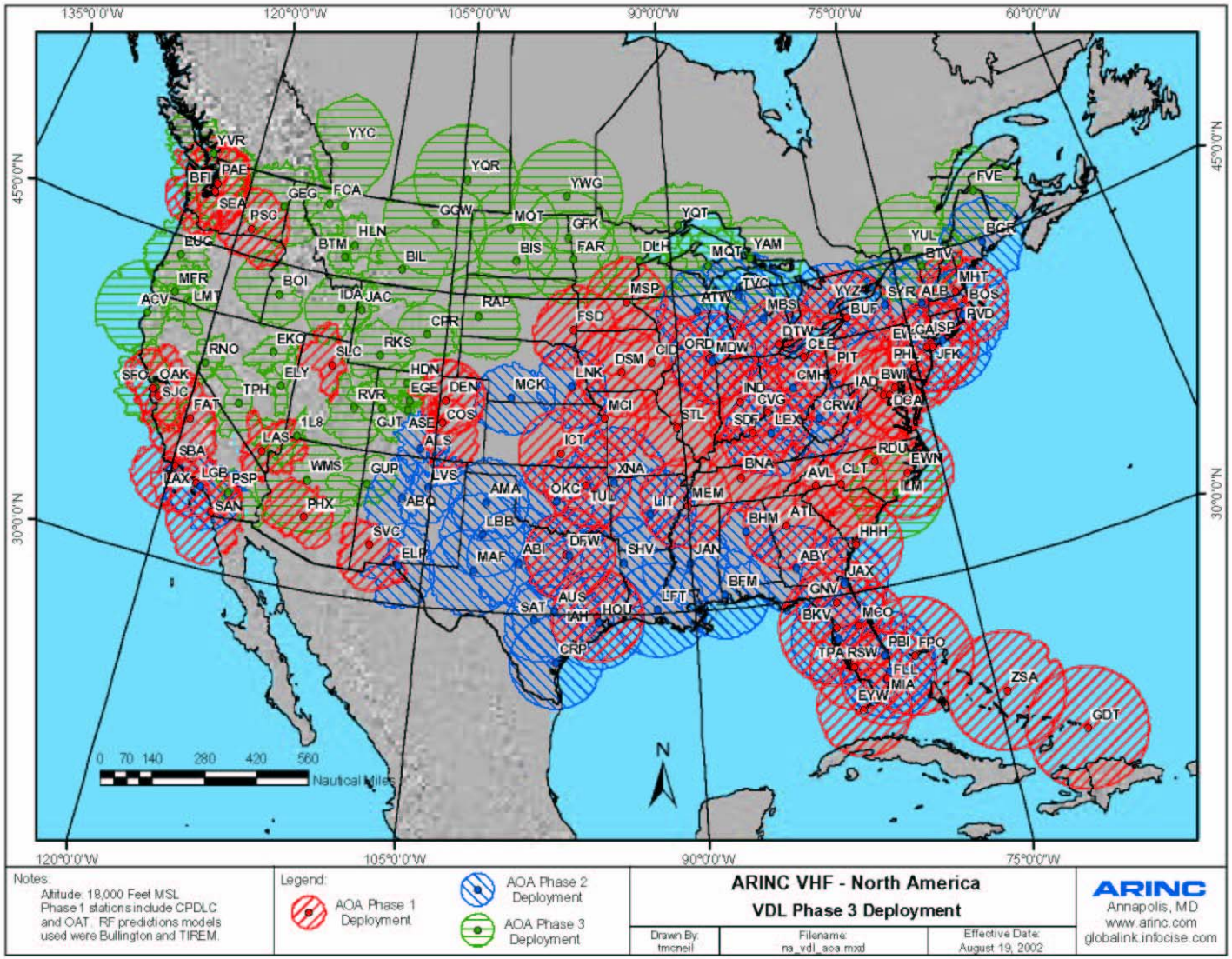
ARINC VDL Mode 2 Services Offered Today

- AOA
  - ACARS Over AVLC*
  - *(*Aviation VHF Link Control protocol)*
- Controller Pilot Data Link Communications (CPDLC)
  - Air Traffic Services over ATN*
  - *(ICAO Aeronautical Telecommunications Network standard)

VDL Mode 2
Shared AOC and ATC Network

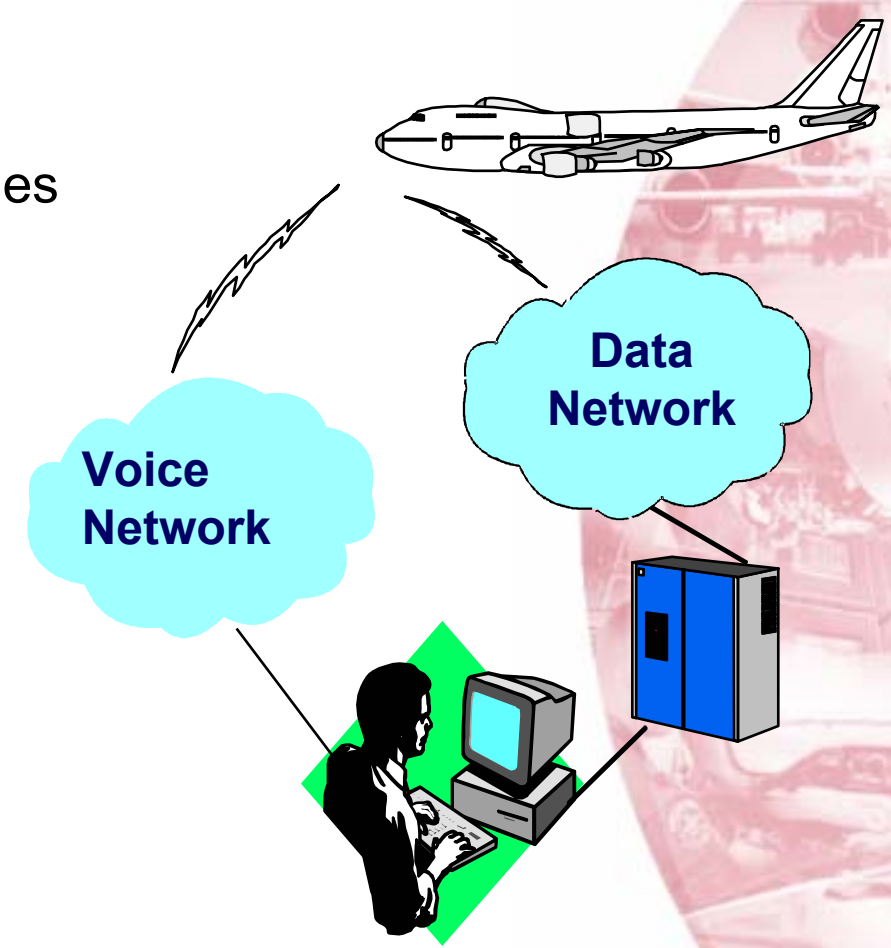


ARINC VDL Mode 2 Coverage USA - 2003



Controller Pilot Data Link Communications (CPDLC)

- Air Traffic Control (ATC) communications via text messages
  - Like Instant Messaging (IM)
- For routine and non-emergency communications
- Voice always primary



More Efficient ATC Communications

- Greatly reduced Voice Radio Utilization Time
- Ability to Review and Confirm Message Content
- Ability to Transmit More Information in the Same Period of Time

Leads to Fewer and Shorter Airline Delays And Greater Airspace Capacity

Benefits of CPDLC

Fewer and Shorter Airline Delays And Greater Airspace Capacity

- Reduced Ground Delay
- Expedited weather re-routing
- Less holding
- Better on-time performance

Leads to Airline Cost Savings

Enhanced Flight Safety

- Reduced In-flight Communications Errors
- More Timely and Understandable Clearances
- More Orderly Flow and Fewer Deviations During Traffic Rushes

FAA CPDLC Build 1 Program

- FAA program to build, test, deploy, and put into operational service CPDLC over VDL Mode 2/ATN
  - One ARTCC (Miami) For En-route Traffic
  - Initial Daily Use (IDU) October 7, 2002
  - Operational Service Planned Through 2005

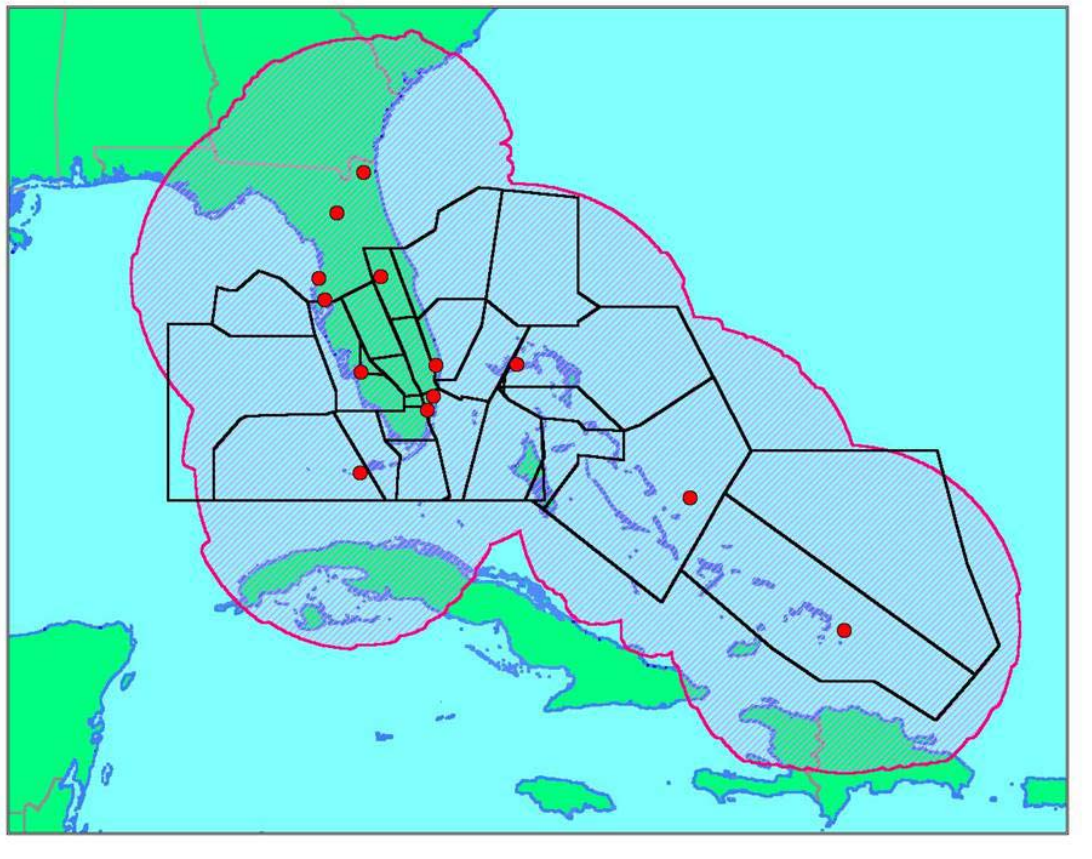
CPDLC Build 1

- Limited set of pre-formatted, routine messages
  - Initial contact
  - Transfer of Communications
  - Altimeter Setting
  - Menu Text

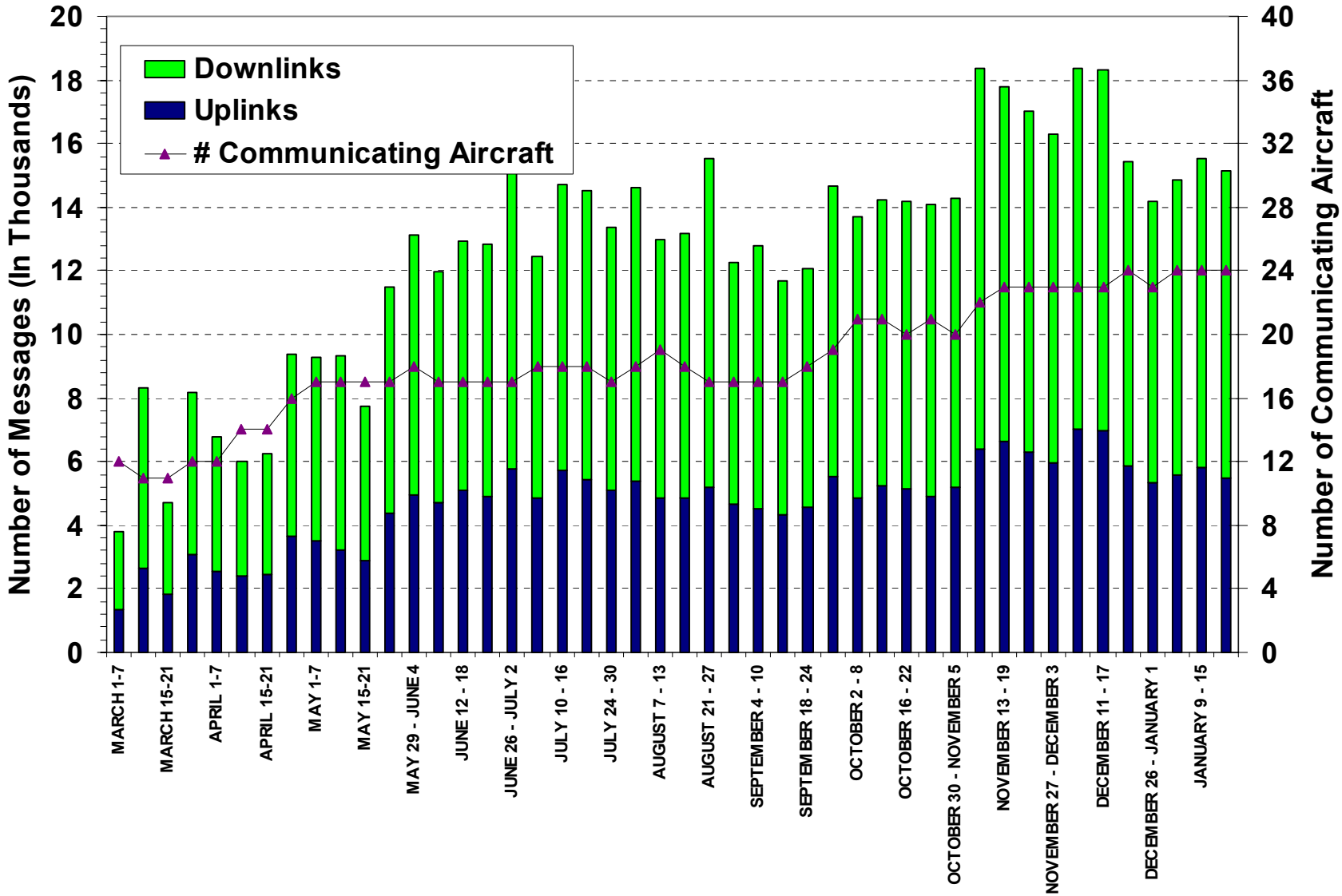
- FAA, American Airlines, Rockwell Collins, CSC, and ARINC are “launch partners”

ARINC ATN / VDL Mode 2 Network

- 13 Station VDL Mode 2 ATN Network
- Entirely redundant system - 24/7
- Operational Sept. 2002
- Availability since IDU
  - 99.9998% - domestic
  - 99.86% - Caribbean



Performance of VDL Mode 2 AOA



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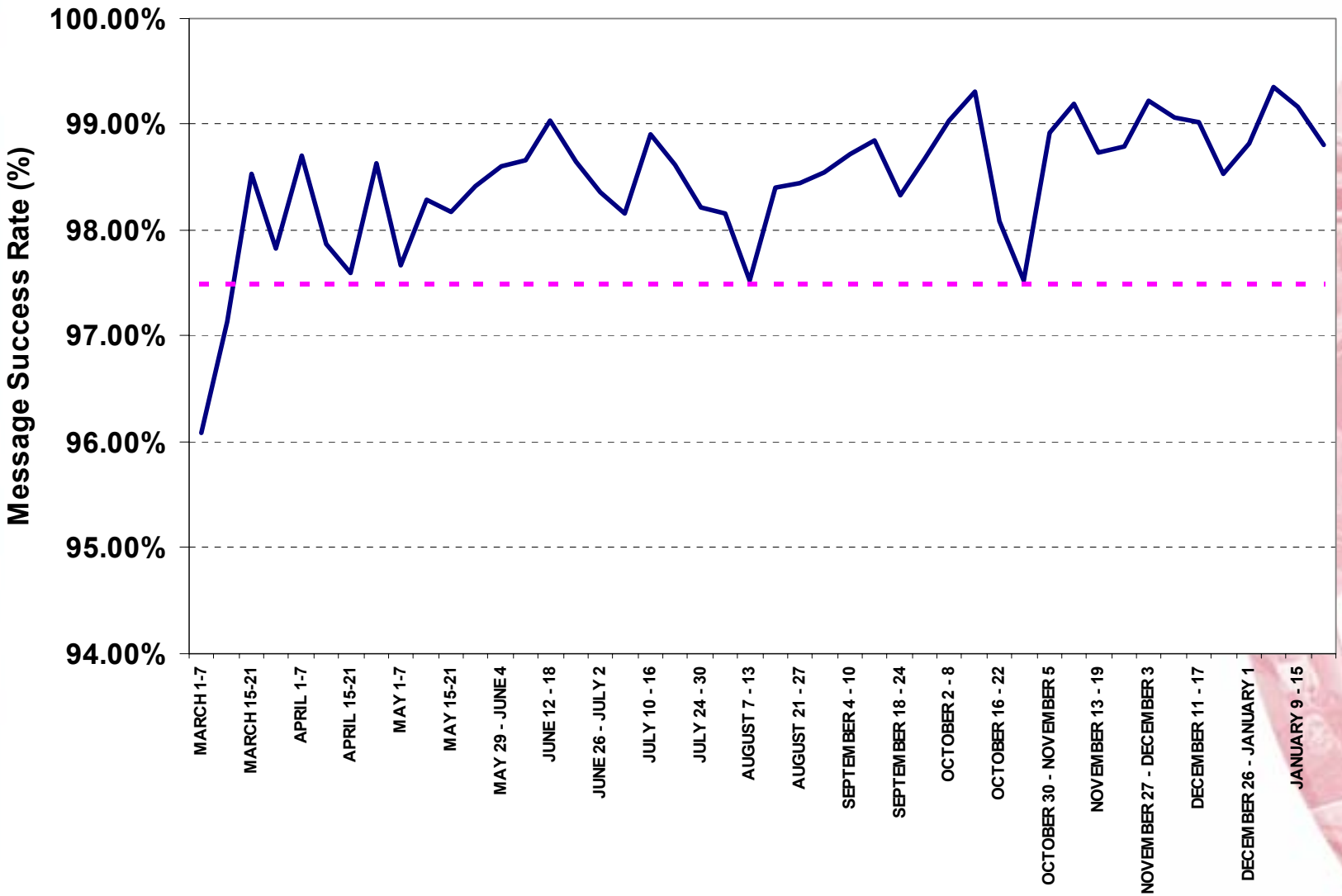
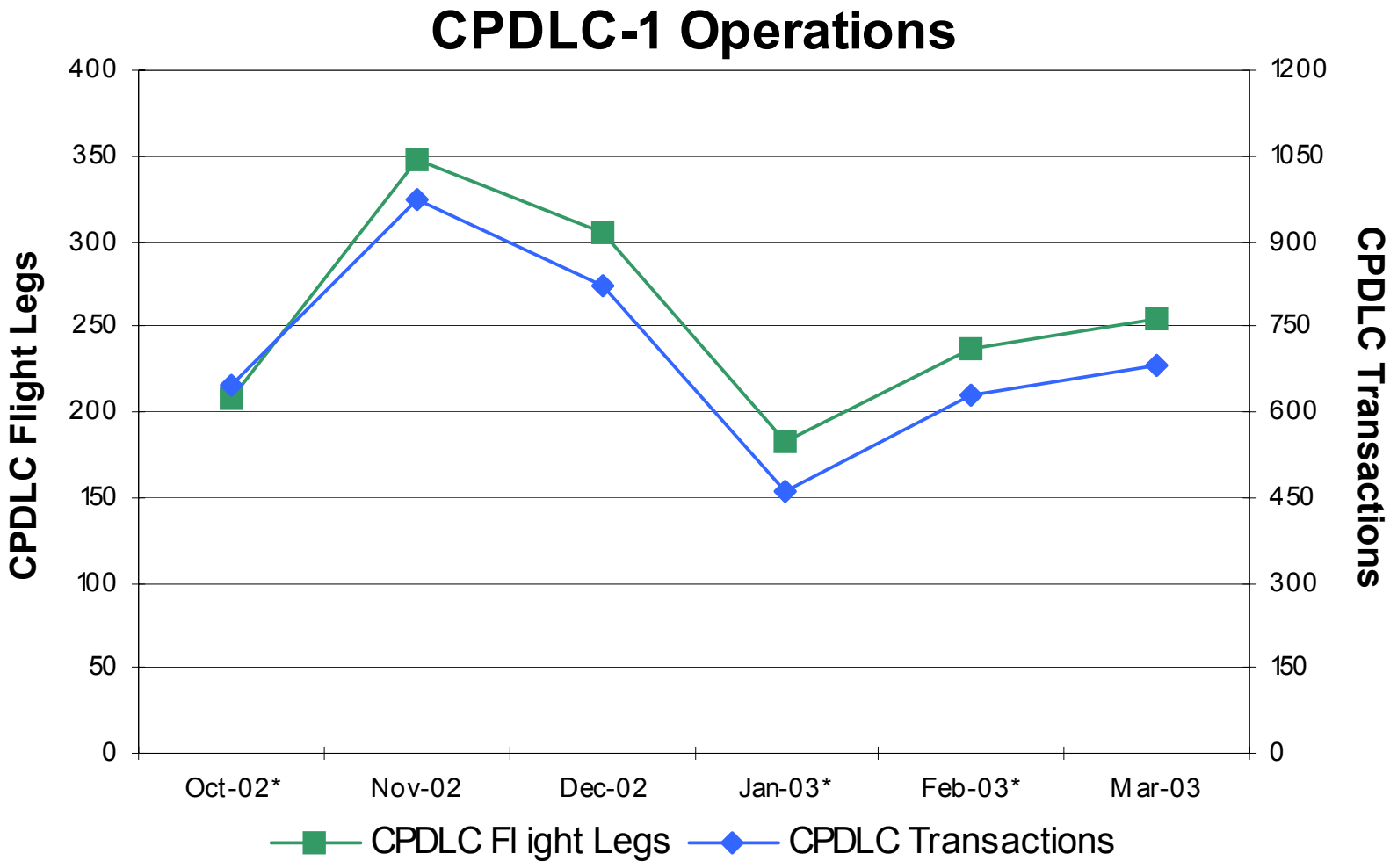
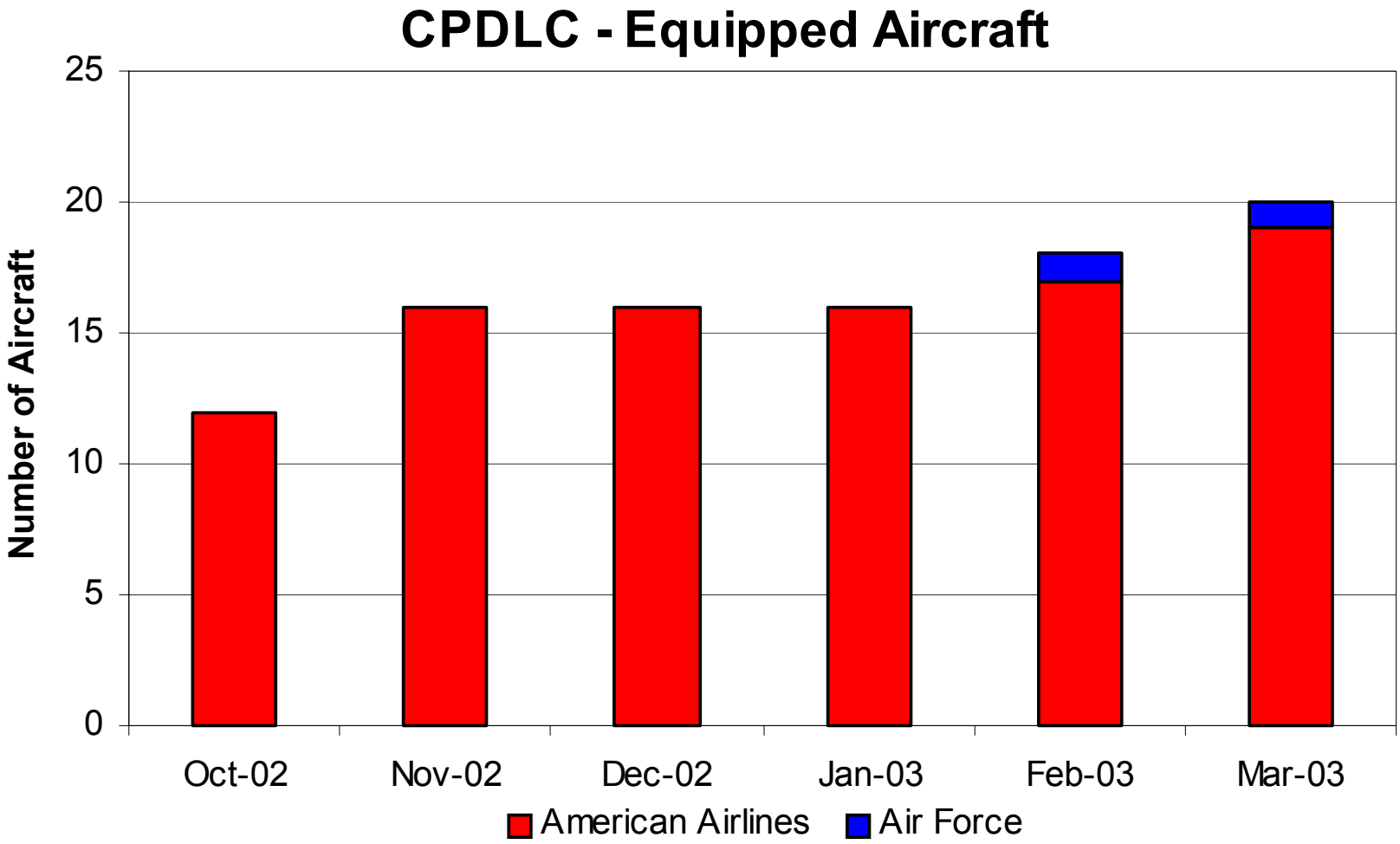


Performance of VDL Mode 2 AOA

- 60,000 ACARS messages monthly
- 99% Uplink success rate
- Response time (in seconds)
  - Average 1.35
  - 90th percentile 1.00
  - 95th percentile 3.00



Data from MITRE Report to Build 1 CIT



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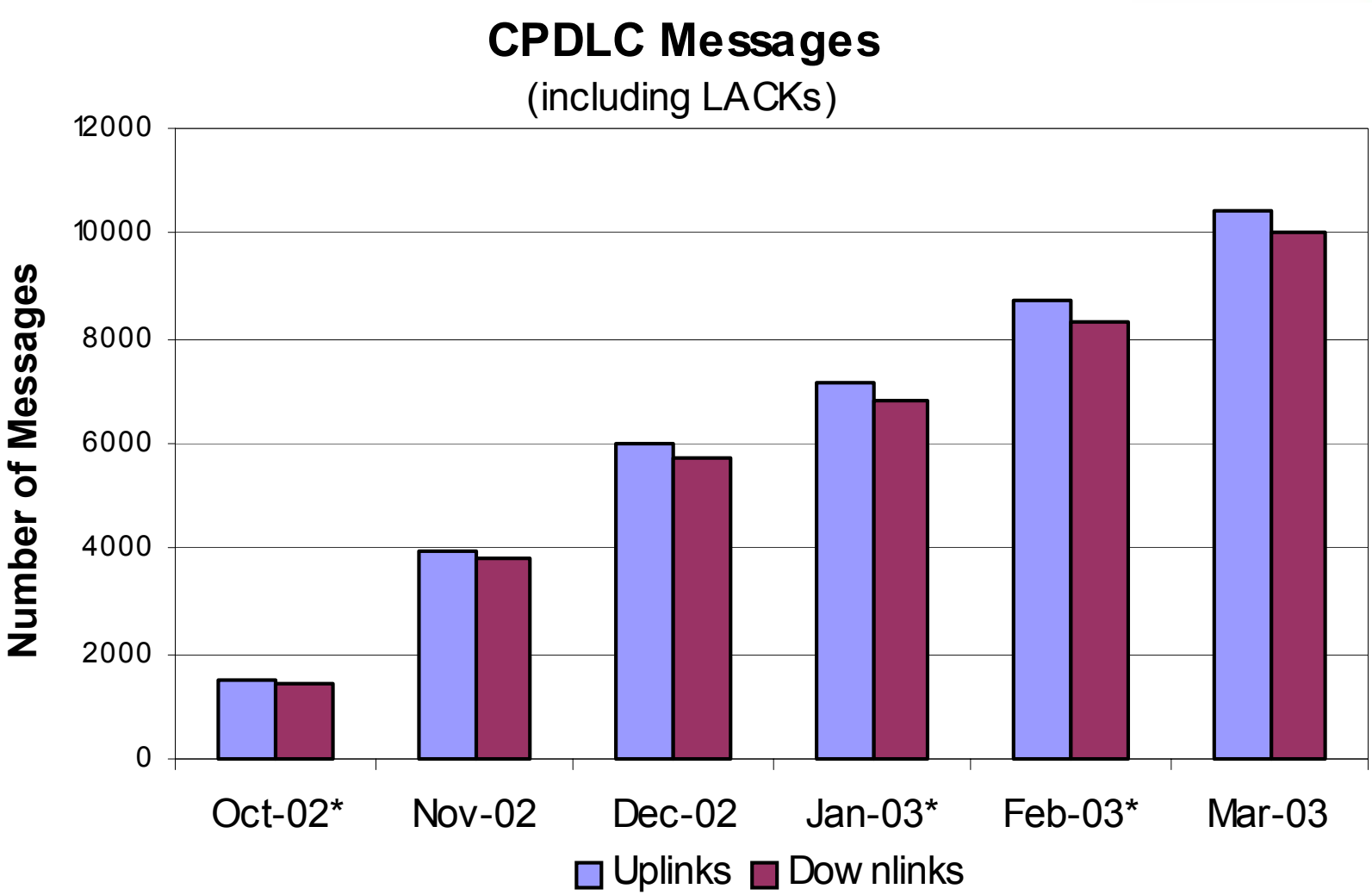

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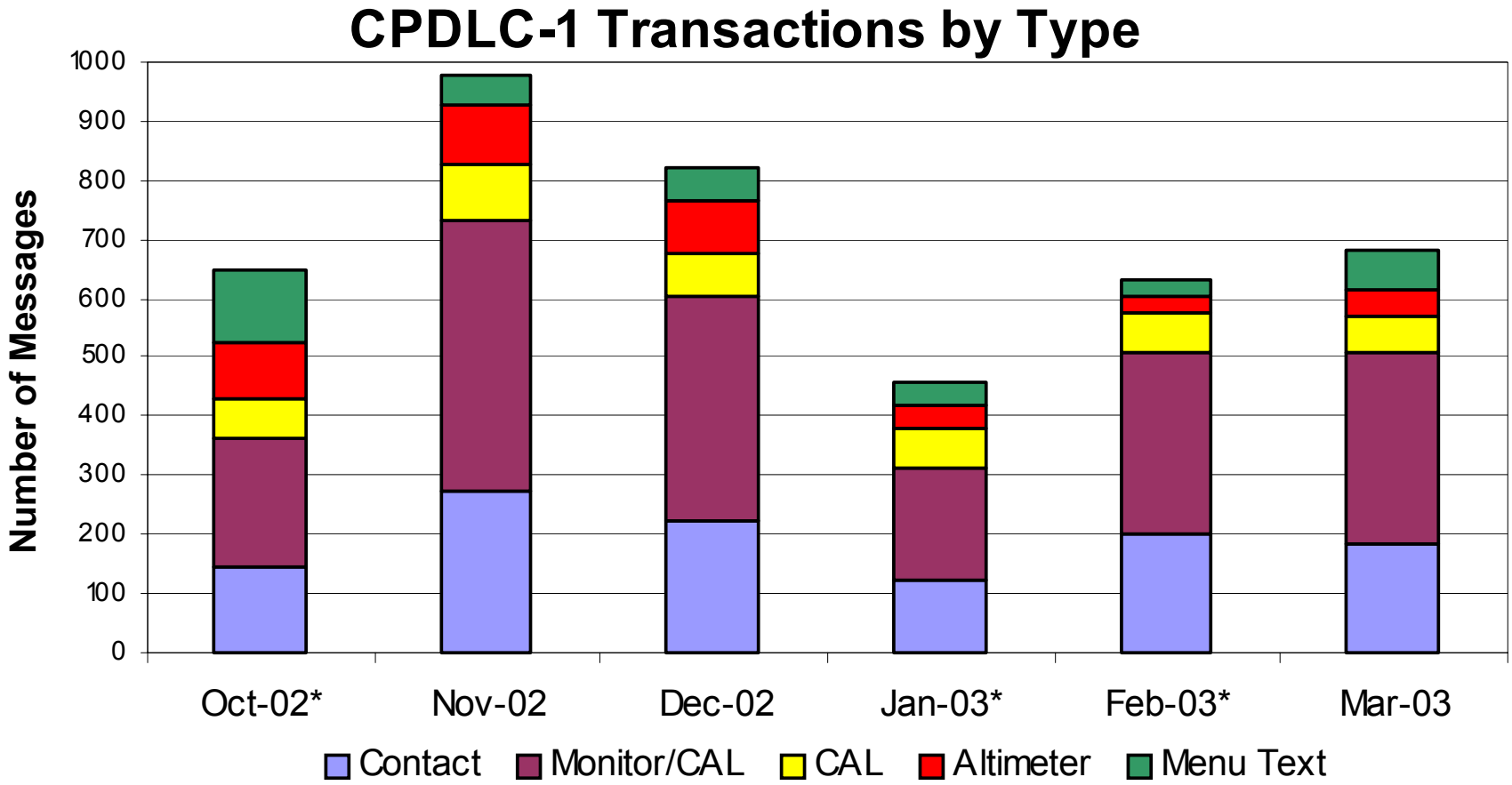

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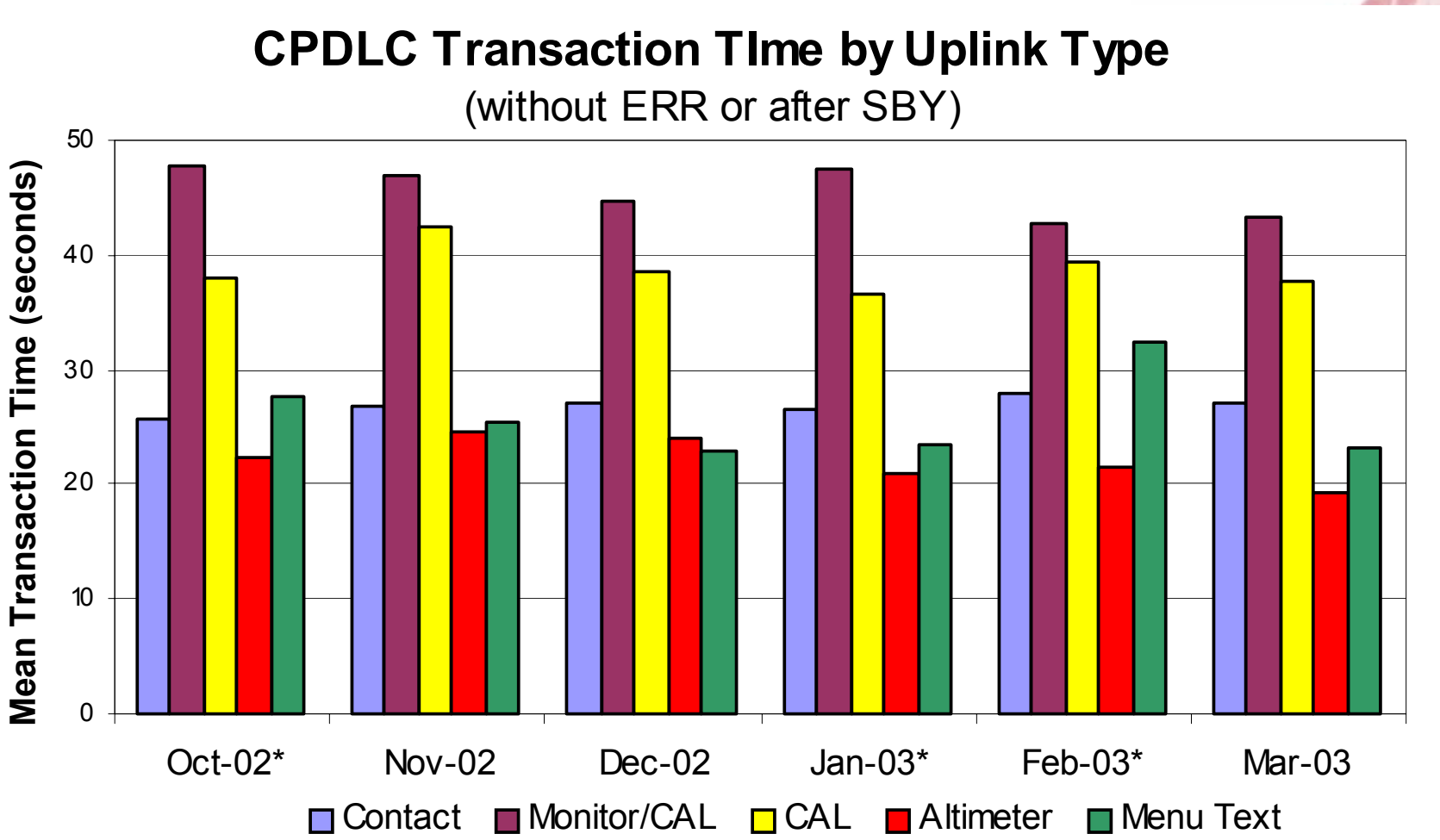

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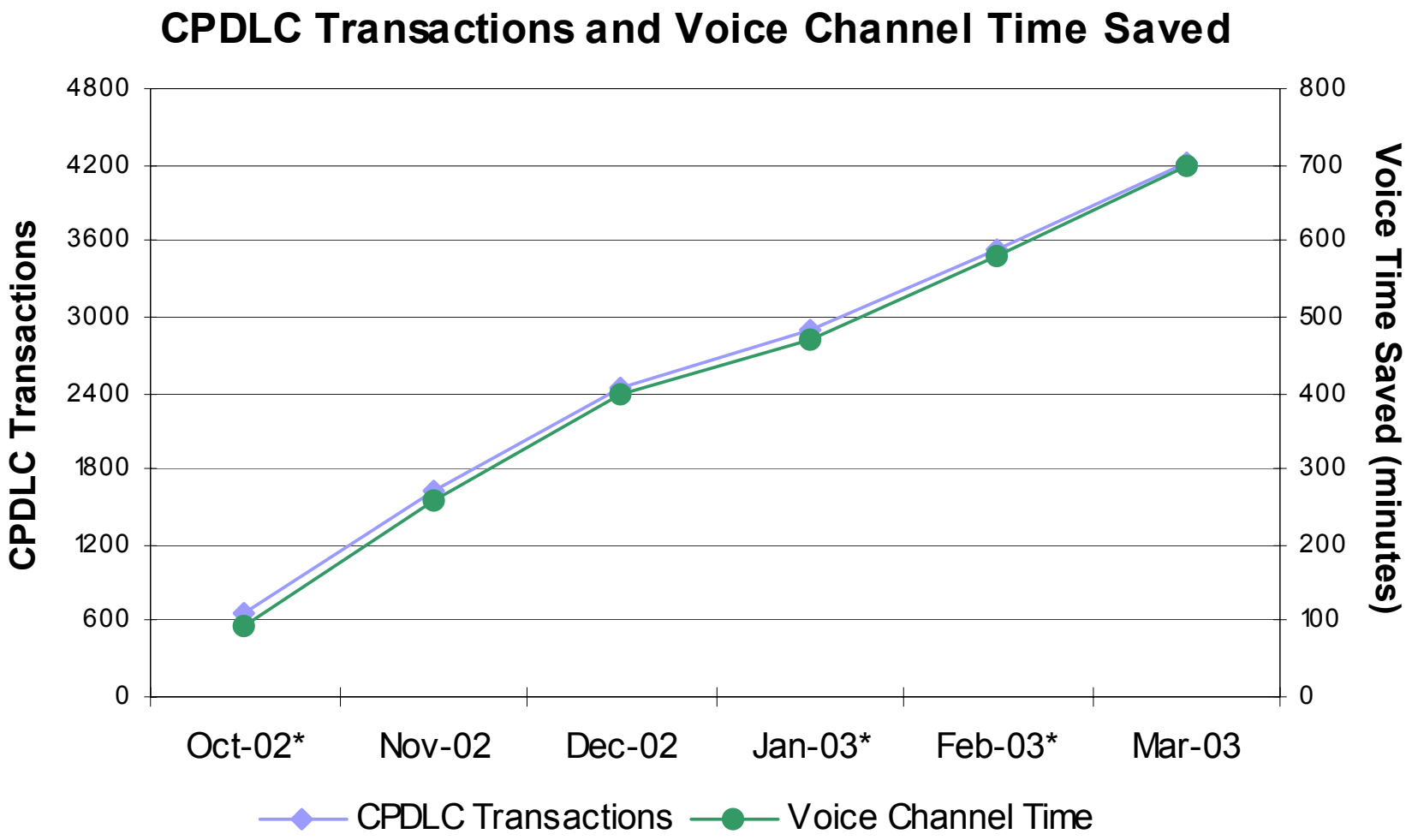
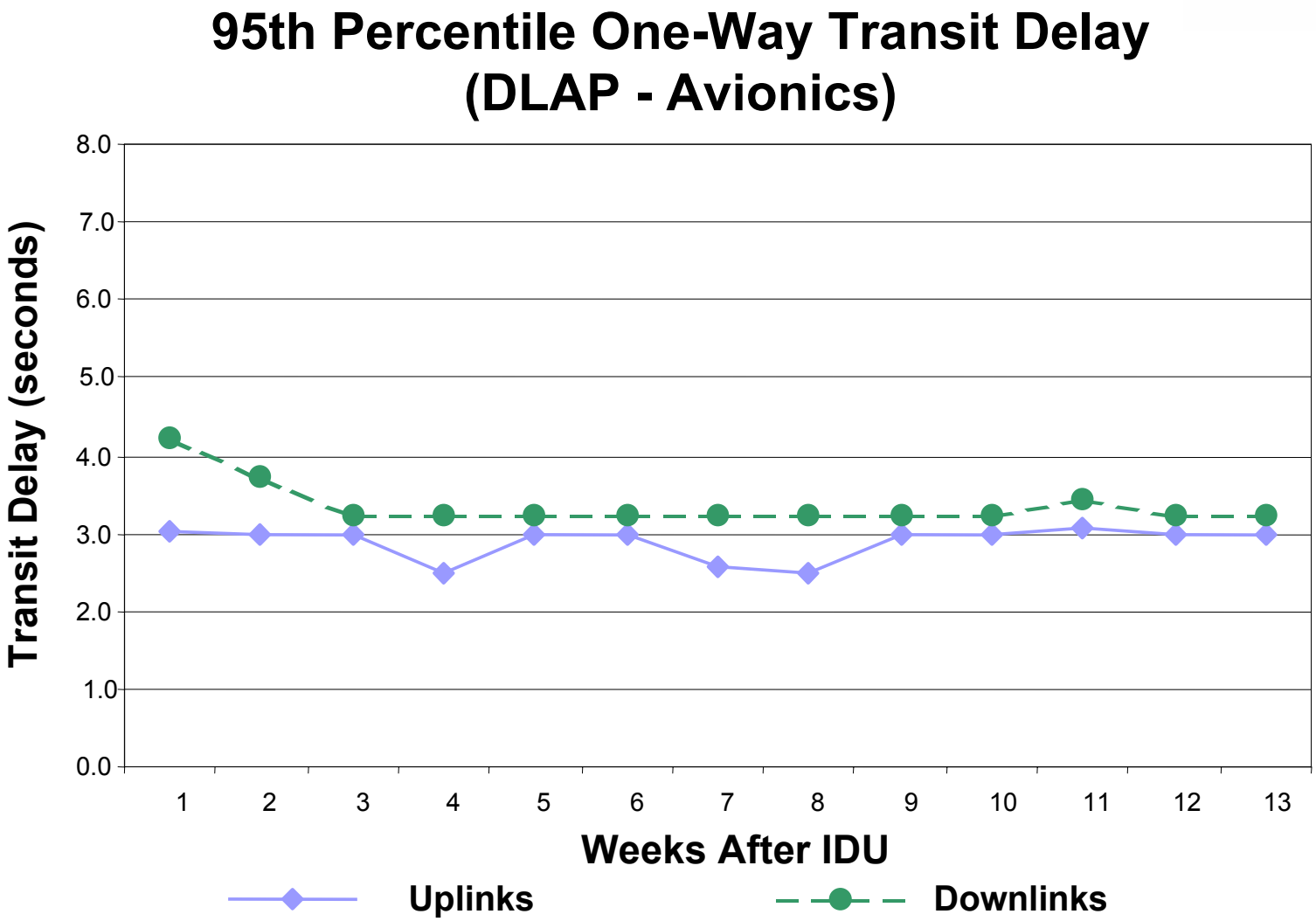


Data from MITRE Report to Build 1 CIT

Build 1 Operational Results



Data from MITRE Report to Build 1 CIT

Build 1 Airlines / Operators / Avionics

- American Airlines operational with 20 aircraft
  - Rockwell Collins VDL/ATN avionics certified
  - Additional aircraft planned in 2003
- USAF Standards Agency operational with 1 aircraft
  - Rockwell Collins avionics installed
- Continental joining in 2003 (4 aircraft)
  - Rockwell Collins avionics
  - STC planned 2Q2003

Build 1 Airlines / Operators / Avionics (cont'd)

- Delta joining in 2003 (4 aircraft)
  - Teledyne avionics in development
  - Planned first flight in 3Q2003
- Fed Ex planning to join Build 1 (? aircraft)
  - Rockwell Collins avionics
- Others
  - Link 2000 may bring European operators
  - Business, Regional operators interested

CPDLC Build 1A

- National Deployment - 20 ARTCCs

- Build I Message Set, Plus
  - Altitudes
  - Speeds
  - Headings
  - Routings
  - Pilot Downlinks
  - Crossing Restrictions

Future CPDLC Plans in USA

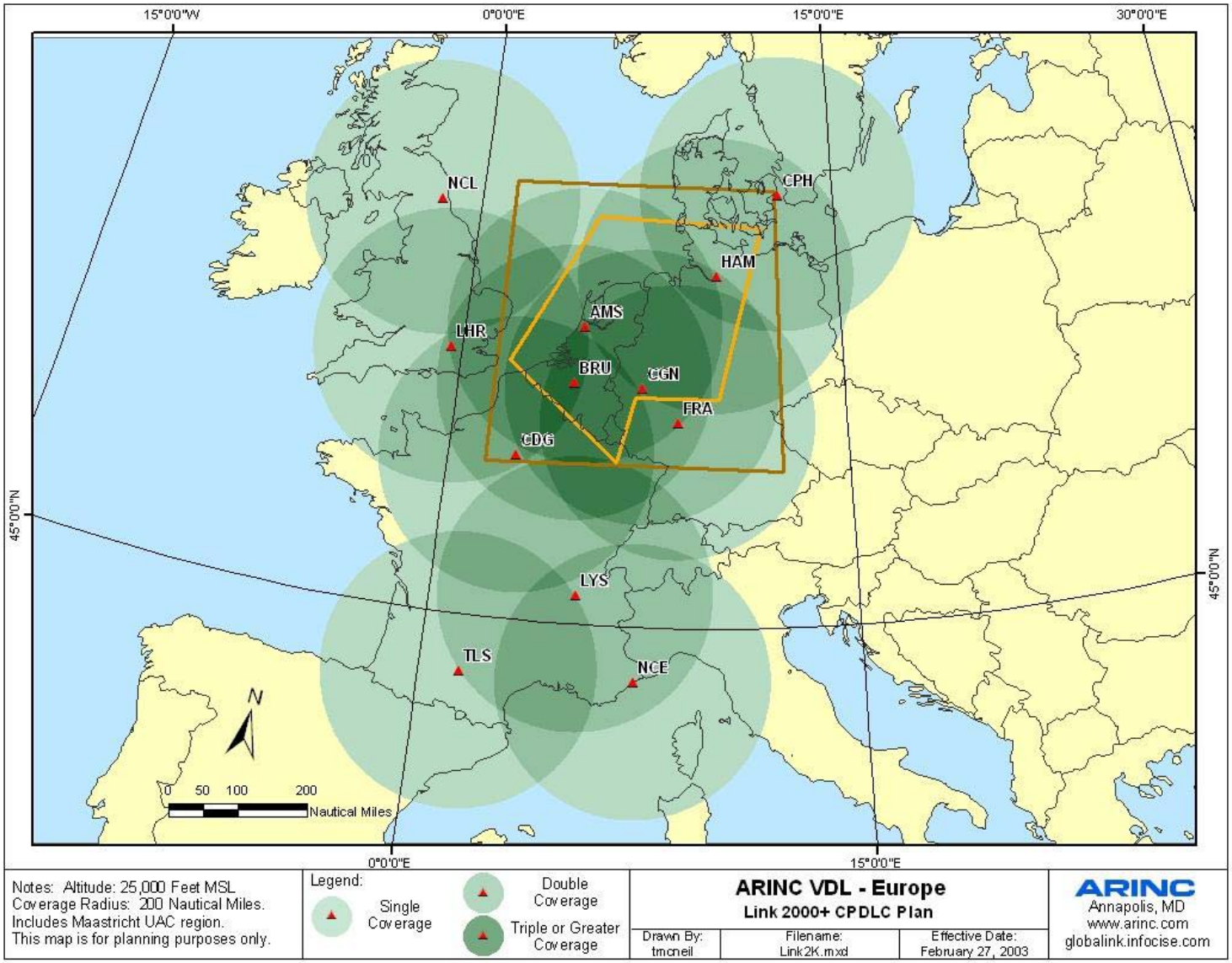
- Planning underway among CPDLC Stakeholders for continuation of Build 1

- Considerations
  - Benefits demonstration
  - Aircraft equipage
  - Use of Free Text for additional functionality
  - Certification, Airworthiness acceptance
  - Cost
  - Additional sites
  - Additional messages

LINK 2000+
Project Pioneer

- Eurocontrol released RFP on 18 February 2003 for ATN/VDL Mode 2 Communications Service Providers
- CPDLC in Maastricht Upper Air Center (UAC)
  - Operational service begins in 2003
  - Expansion planned to additional centers
- Pioneer airlines (SAS and LH)
  - Twenty (20) airplanes each anticipated

Initial LINK 2000 Coverage



Summary

- VDL Mode 2 AOA and ATN networks are operational
- VDL Mode 2 avionics for AOA and ATN are available
- FAA CPDLC service is operational in Miami ARTCC over ARINC VDL Mode 2
- European CPDLC service will be operational in 2003
- CPDLC over VDL Mode 2 is achieving promised performance